1 ECMT2130 - 2022 semester 2, assignment 1

Author: Geoff Shuetrim

Your answers need to be submitted using the Canvas quiz for assignment 1. The R script and Microsoft Excel spreadsheet produced in doing this assignment must be uploaded using this Canvas quiz. These documents must be your own work.

1. **Portfolio optimisation**

   Use the data allocated to you to answer the following questions.

   Throughout this assignment, all rates of return are simple monthly rates of return (not annualised), expressed as a decimal rather than a percentage. Thus, for example, a rate of return of 5% would be expressed in the data set as 0.05.

   Unless otherwise stated: the investor can invest in all of the managed funds but cannot invest in the risk-free asset; and the investor is fully invested.

   Use the most recent value of the simple monthly risk-free rate of return as the "current risk-free rate of return" when analysing the following portfolio optimisation problems.

   Compute the excess rates of return for each fund, in each available time period. Add the current risk-free rate of return to these excess rates of return for each fund to produce simple monthly rates of return that do not incorporate risk-free rate of return variation as a source of risk.

   Compute mean simple monthly rates of return on a fund using these adjusted simple monthly rates of return (average over the entire available sample). If this is not clear, ask for clarification on Ed!

   Also use these adjusted simple monthly rates of return to estimate the variance-covariance matrix for the funds' rates of return. Again, use the entire available sample.

   (a) (2 points) Estimate the mean and the standard deviation of the simple monthly rate of return for the Global Minimum Variance Portfolio (GMVP). Report the standard deviation as a percentage, to 2 decimal places.

   (b) (2 points) Estimate the mean and the standard deviation of the simple monthly rate of return for the portfolio with minimum variance when shorting is allowed but no fund is allowed to have a weight with an absolute value greater than 20%.

   (c) (2 points) Estimate the mean and the standard deviation of the simple monthly rate of return for the portfolio with minimum variance when no shorting is allowed and no fund can have a weight above 20%.

   (d) (2 points) Estimate the standard deviation of the simple monthly rate of return for the minimum variance portfolio that has an expected simple monthly rate of return that is double that of the GMVP.

   (e) (2 points) Estimate the slope of the optimal Capital Allocation Line when the investor can invest in the risk-free asset and faces no portfolio weight restrictions (other than the full investment requirement). Use the current risk-free rate of return when solving this problem.

   (f) (2 points) Estimate the mean and the standard deviation of the rate of return for the optimal portfolio for an investor with expected utility described by the following equation:

   $$E(U) = E(r_p) - 2\sigma_p^2 \tag{1}$$

   Assume that the investor can invest in all of the risky funds and in the risk-free asset and assume that there are no constraints on their asset weights (aside from the full-investment requirement).

   (g) (2 points) Using the asset weights for the optimal portfolio of the investor with expected utility shown in equation 1, estimate the excess kurtosis of the portfolio's simple monthly rate of return. Use all of the available historical data to produce this estimate.

   (h) (6 points) Critique the optimal portfolio weights found for the investor in part F, in terms of their portfolio optimisation methodology. This part must be answered in no more than 300 words.

2 Assessment data

Each dataset is a numbered file that ends with the ".RData" suffix. Each file is an RData file, containing the name and value for a number of R variables. You need to write an R script to load the variables from the right dataset file and analyse the data stored in these variables.

All of the RData files are contained in the same ZIP file that is available on Canvas. Download that ZIP file, extract its contents and then analyse the data in the RData file that is allocated to you. *The number of the data file that you have been allocated is listed beside your name in the assignment page on Canvas.*

Download the zip file containing all of the possible data files and the starting point R script for the assignment and extract the contents of the zip file into the folder where you want to do your work.

Your dataset contains 3 eXtensible Time Series (XTS) variables:

- fundTotalReturnIndices
- riskFreeRateOfReturn
- markexTotalReturnIndex

Each of these variables contains monthly data relating to rates of return from the beginning of 2000, to the end of 2021.

The total return index for the portfolio managed by each of different fund managers is contained in the variable named fundTotalReturnIndices. The total return index for the fund manager "i" has column name:

`v_i`

The data for the monthly risk-free simple rate of return is stored in the riskFreeRateOfReturn variable and its column name is:

`r_i`

The monthly data for the market total return index is stored in the markexTotalReturnIndex variable and its column name is:

`v_m`

You can load the variables from your RData file by running the R function:

```
load("Assignment 1 dataset X.RData")
```

replacing "X" with the number of the data set that has been allocated to you.

Make sure that folder containing your data file and your R script is your working directory in R Studio.

Evidence of work

Write an R script that uses the provided data to compute the data you want to export to Microsoft Excel for portfolio optimisation. Note that you can make your own choices here. Use R or Excel, for example, to estimate the relevant means, variances and covariances that you need to use to solve the portfolio optimisation problems.

You can save data to a CSV file using the R command:

```
write.csv(variableName, "nameOfCSVFile.csv", sep=",")
```

The grid of data in the variable called "variableName" will be written out to the named CSV file with commas separating each item in each row.

Load the data from the CSV file or files that you exported from R into an Excel workbook and then solve each portfolio optimisation problem on a separate worksheet in that workbook. The use of a separate worksheet for each problem is required so that markers can review the solver configurations for each problem. If any solver configurations cannot be reviewed, you are unlikely to receive full marks for the associated optimisation problem.

Upload your final R script and your Excel workbook along with your other answers to the Canvas quiz questions for Assignment 1. Your assignment will be marked based upon those quiz answers and your final R script and Excel workbook. The R script needs to include the code and comments necessary to demonstrate how your reached your conclusions.

Your marks will be determined by teaching staff based upon their review of your answers. The built-in Canvas quiz answers are the same for everyone and only serve to check that your answers are within a very wide range of values. *Do not interpret Canvas automarks as your final marks for the assignment.*

If you do not upload your R script or Excel workbook, your assessment score will be zero.

Make sure your uploaded documents are your own work. Markers use a wide range of automated methods to detect plagiarism.